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Description

[Stir-frying Apparatus with Over-head Heating Device]

BACKGROUND OF INVENTION

[0001] This invention generally relates to cooking/food processing apparatuses. More specifically, this invention relates to stir-frying apparatuses with an over-head heating device.

[0002] Stir-frying of meats and vegetables without the use of oil or with the use of very little oil has become increasingly popular in recent years as the population has become more health conscious. Frying adds a unique taste to the food product while the use of no cooking oil (or at least very little) minimizes the amount of fat in the diet. By quickly frying vegetable products on a very high temperature heated surface (e.g., 425 degree F to 600 degree F) the vegetable product maintains a crisp, fresh texture. This frying process has been used for centuries by Asian population and in recent years has become very popular in

Western World.

[0003] Chinese stir-frying cooking is the brisk cooking of small cuts of meats and vegetables in hot oil over intense heat, calling for split-second timing and swift movements in an uninterrupted rhythm. Two elements are crucial to stir-frying. Firstly, thorough organization, in the sense that everything needed is within reach, such that no interruption will disturb the cooking once it starts; and secondly, vigilance from the person who must be ready to measure and add ingredients, and adjust timing and volume of heat instantly. Each dish is allowed to cook for only several minutes. This cooking process requires considerable skill in judging the progress of a dish by the smell, look and feel of the food, and the sound of the cooking. Were there a way to capture and multiply the knowledge and the skills of a good Chinese chef, a whole new opportunity would be created for expansion in home food preparation and restaurant industries.

[0004] There are some other important issues associated with preparing stir-fried foods, especially cooking at home, which need to be tackled.

[0005] First, the contact of moisture-containing raw foods with hot oil produces grease splattering. Most times, the splat-

tering liquids and food particles reach out of frying apparatuses to considerable distances. These will not only mess up stovetops and surrounding surfaces but also create undue oil burn injuries to the people who are preparing fried foods. The problem of grease fires in kitchens as well as severe oil burns to people has been well documented.

[0006] Second, oil vapor is produced when oil is heated. The people who are preparing fried foods involuntarily inhale considerable amount of cooking fumes during cooking processes. Oil vapor is harmful to human health and might pose long-term health threats to the people who expose themselves to oil vapor on a very regular base. The oil vapor generated in cooking processes might easily reach much farther in the kitchen or even other rooms and deposit on the furniture, paintings, electrical appliances, etc., causing long-term hazards to home environment.

[0007] Third, If the layer of food pieces on the heated surface is more than 2 or 3 inches deep, the portion of the food pieces being heated on the bottom layer gives off steam. This steam rises through the food pieces above, thereby steam cooking them, such that the prepared food be-

comes limp and soggy. Applying heat only to the bottom can result in the upper portion of food being insufficiently heated. The heat distribution problem cannot be resolved by simply increasing the power output of the bottom-heating element. This is due to the fact that the increased heating output tends to locally overheat the bottom layer of food pieces.

[0008] Over years, various devices have been developed to address some of these problems associated with stir-frying.

[0009] US Patent Application No. 10/604,389, filed by Zhaoxia Xu and Zheng Peng, on July 17, 2003, teaches an automatic frying apparatus for both deep and shallow frying. The frying apparatus comprises a container for holding foods and oil, a lid covering on top of the container, a bottom heating device installed underneath the container, a stirring blade rotatably and removably installed inside the container, on the central bottom, a power-drive assembly operationally coupled with the stirring blade for driving the stirring blade through repeating stirring cycles, a blowing device for forcing fresh air into the frying apparatus for the removal of moisture inside the container, and a venting device for filtering and deodorizing cooking fumes.

[0010] One disadvantage associated with this prior art is that it is specifically designed for frying, deep or shallow. It is surely advantageous if its functionality can be extended, for example, extended to cover roasting, baking, etc., such that consumers can buy just one appliance to use for frying, roasting, baking, etc., and such that the benefits of frying and roasting can be combined to heat foods more efficiently and to prepare healthier foods.

[0011] U.S. Patent No. 4,649,810, issued to Wong, on Mar.17, 1987, illustrates an automatic cooking apparatus having a compartmentalized carousel for various ingredients of a particular dish to be loaded and a stirring blade generally conforming to the shape of the bottom of a cooking vessel. As the blade revolves around a vertical axis, it causes the foods to spread and to roll over the top of the blade.

[0012] U.S. Patent No. 4,779,522, issued to Wong, on Oct. 25, 1988, illustrates an automatic cooking apparatus having a Geneva drive mechanism for intermittently and selectively rotating one or more drive shafts through indexed positions.

[0013] U.S. Patent No. 4,820,054, issued to Wong, on Apr.11, 1989, illustrates a stirring mechanism, which provides a stirring action having horizontal and vertical rotation.

[0014] The proposed designs of the above three prior art products, issued to the same inventor, might be useful for stir-frying, but they are generally too complicated in configuration and are too difficult to clean after use. In additions, they failed to address the need of optimizing heating systems, the issues of cooking fume hazards to users and their home environment, and the issue of the upper layers of food pieces being steam cooked. These are among many other reasons why these prior art products are not appealing to the market and general public.

[0015] While other automatic food preparation apparatuses have been introduced in the past, and some were specially designed for cooking Chinese dishes, various problems and drawbacks have hindered their commercial viability and success.

[0016] Electrical frying apparatuses are popular home appliances nowadays. However, these oil fryers have been known to cook their baskets' foods unevenly. Additionally, many fried items retain too much oil and, when removed from the fryer, remain greasy and generally unwholesome. Moreover, such appliances require large quantities of frying oil, long frying times, and large quantities of energy for heating the frying oil.

[0017] Therefore, it remains desirable to provide stir-frying apparatuses that can be used to combine the benefits of frying, roasting, and baking, etc.; that can reduce the time required for proper cooking; that are automatic to minimize the human involvement or chore during the frying process, that favors homogeneous heating of foods, that require minimal quantity of oil for frying foods, that can effectively and efficiently remove the surface moisture content of food pieces to achieve the characteristic of low fat absorption and great looking, taste, and texture of foods, that are inexpensive to manufacture and simple and easy to use, and also that are people and home environment friendly.

SUMMARY OF INVENTION

[0018] Accordingly, the present invention is a stir-frying apparatus with an overhead-heating device. This stir-frying apparatus comprises a container having an open top for holding foods, a lid covering on top of the container for closing up the open top, a bottom heating device installed underneath the container for heating foods from below and an overhead heating device installed at an upper position of the apparatus for heating foods from above, a stirring blade rotatably and removably installed inside the

container, on the central bottom, a power-drive assembly operationally coupled with the stirring blade for driving the stirring blade through repeating stirring cycles, a blowing device for forcing fresh air into the apparatus for the removal of moisture inside the container, a venting device for filtering and deodorizing cooking fumes, and a ingredient adding conduit to be used for adding various ingredients during a frying process.

[0019] The stirring blade sweeps across food pieces in an intermittent operation, in which it dwells for a predetermined dwell period near the end of each stirring cycle. This intermittent operation affords relief from constant stirring of food pieces at a higher speed, thereby favoring foods of great texture and looking.

[0020] Cooking fumes are treated right before leaving the apparatus, whereby this stir-frying apparatus of the present invention is people and home environment friendly.

[0021] Accordingly, the followings are some of the objects, features, and advantages of the present invention.

[0022] It is an object of the present invention to provide a stir-frying apparatus for use to prepare tasteful and healthy stir-fried foods and to combine the benefits of frying, roasting, baking, etc. to achieve more efficient heating of

foods.

[0023] It is another object of the present invention to provide a stir-frying apparatus that prepares foods faster, thereby saving users' time in preparing foods, and that is automatic for stir-frying to reduce the labor chore in preparing foods.

[0024] It is a further more object of the present invention to provide a stir-frying apparatus that is people and home environment friendly.

[0025] It is a feature of the present invention that this stir-frying apparatus has a bottom heating device and an overhead-heating device to execute a "3D" heating effect on foods, such that the required cooking time is significantly reduced and the food quality is enhanced.

[0026] It is another feature of the present invention that this stir-frying apparatus has a stirring blade rotatably and removably installed on the central bottom of a container for stirring foods. The blade sweeps across food pieces in an intermittent operation, in which it dwells for a predetermined interval of time near the end of each sweeping cycle and then automatically begins another cycle of operation. This intermittent operation affords relief from constant stirring of food pieces at a higher speed, thereby fa-

voring foods of great texture and looking.

[0027] It is a further more feature of the present invention that this stir-frying apparatus has a forced venting system including a blowing device to force fresh air into the stir-frying apparatus for the moisture removal from therein-side and a venting device for removing the oil vapor content in the grease-laden air generated during a frying process before the air is exhausted into the room.

[0028] It is an advantage of the present invention that this stir-frying apparatus is virtually hand-free for stir-frying foods.

[0029] It is another advantage of the present invention that this stir-frying apparatus is oil splashing free and cooking fume free, such that it is people and home environment friendly.

[0030] It is a further more advantage of the present invention that this stir-frying apparatus reduces required cooking time and prepares high quality and healthy foods.

[0031] Further more features and advantages of the present invention will be readily appreciated, as the same becomes better understood after reading the subsequent description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0032] FIG. 1 illustrates a cross-sectional view of an embodiment of the present invention, stir-frying apparatus *100*.

[0033] FIG. 2 illustrates a cross-sectional view of stir-frying apparatus *100*, taken along line A-A of FIG. 1.

[0034] FIG. 3 illustrates a top view of stir-frying apparatus *100*.

[0035] FIG. 4 illustrates a cross-sectional view of stir-frying apparatus *100*, taken along line A-A of FIG. 3, indicating blowing device *202*.

[0036] FIG. 5 illustrates a cross-sectional view of stir-frying apparatus *100*, taken along line B-B of FIG. 3, indicating safety switch *254*.

[0037] FIG. 6 illustrates an exploded cross-sectional view of stirring blade *1 36*.

[0038] FIG. 7 illustrates an exploded cross-sectional view of seal device*144*.

[0039] FIG. 8 illustrates a cross-sectional view of one-way valve *218* of FIG. 4.

[0040] FIG. 9 illustrates a blocked diagram of control circuit *1 6 2* for stir-frying apparatus *100*.

[0041] FIG. 10 illustrates a schematic diagram of control circuit *50* for providing an intermittent operation of blade sweep-

ing for stir-frying apparatus *100*.

[0042] FIG. 11 illustrates a schematic diagram of control circuit *70* for providing an intermittent venting operation of blowing device *202* for stir-frying apparatus *100*.

[0043] FIG. 12 illustrates a perspective view of perforated basket *1 88* to be used with stir-frying apparatus *100* for deep frying foods.

[0044] FIG. 13 illustrates covering mechanism *190*, indicating basket*1 88*, which is in use for deep-frying foods.

[0045] FIG. 14 illustrates covering mechanism *190*, when basket *1 88* is not in use for deep-frying foods.

DETAILED DESCRIPTION

[0046] Reference is made to FIGS. 1-5, which illustrate an embodiment of the present invention, a stir-frying apparatus *100*.

[0047] Reference is made to FIG. 1, which illustrates a cross-sectional view of apparatus *100*.

[0048] Container *102*, having an open top and a central bottom aperture, is provided for holding foods. Container *102* is installed inside an outer container *104*, which is installed inside a housing *106*. The central bottom aperture is provided to allow a drive shaft *108* to thread therethrough. Container *102* is, preferably, coated with a non-stick ma-

terial.

[0049] As shown in FIG. 2, which illustrates a cross-sectional view of apparatus *100*, taken along line A-A of FIG. 1, a lift handle *110* is installed on one side of container *102*, at an upper position. Handle *110* extends from container *102* to outside apparatus *100* through a recession on the upper edge of container *104* and a corresponding recession on the upper edge of housing *106*. A grasp handle *112* is installed on the other side of container *102*, at an upper position. Handle *112* extends from container *102* to outside apparatus *100* through corresponding recessions on the upper edges of container *104* and housing *106*. Handle *112* is lockably hinged, via hinge *112a*, at a position close to container *102*, such that handle *112* can be folded down or sideways to save some space when apparatus *100* is in a packed state.

[0050] A spacing element *114*, installed in between containers *102* and *104*, is provided for positioning and holding container *102* inside container *104*.

[0051] A housing support *11 6*, installed on the outside bottom of housing *106*, is provided for furnishing a bottom support for apparatus*10 0*, such that apparatus *100* is adapted to stand on a flat surface, e.g., a kitchen counter top.

[0052] A bottom-heating device *11 8*, installed on a bracket *118a* in between containers *102* and *104*, around the central bottom thereof, is provided for heating foods disposed inside container *102*. Heating device*11 8* is in a heat-transferable condition, e.g., in physical contact or radiation, with the bottom of container *102*, such that when heating device*11 8* heats up upon connection with an electricity source, foods therein will also heat up. Heating device *11 8* can be electrical resistance type heaters or many other types, such as high-intensity infrared lamps or magnetic heating devices, as known to those skilled in the art and suggested by this invention disclosure.

[0053] Reference is made to FIG. 1, again. A lid *1 20*, having an inner lid *1 20 a* and an outer lid *120b*, is provided for covering on top of container *102* for closing up the open top thereof. Lid *120 a* is installed on lid *1 20b*, which is hingedly installed on housing *106* via hinges *124*. A seal element *126*, installed on lid *120a*, is provided for sealing in between lid *120* and container *102*.

[0054] An overhead-heating device*1 28*, installed on lid *120 a*, is provided for heating foods disposed inside container *102* from above. Heating device*1 28* is preferably in a radiation heat-transferable condition with foods, such that when

heating device *1 28* heats up upon connection with an electricity source, foods therein will also heat up. Heating device *1 28* can be electrical resistance type heaters or many other types, such as high-intensity infrared lamps, as known to those skilled in the art and suggested by this invention disclosure. A covering piece *130*, made of an infrared transparent material, is provided to protect heating device *128* against liquid splattering.

[0055] An observation window *132*, made of a transparent material, is installed on lid *120* for observing frying processes therethrough by users.

[0056] Also illustrated in FIG. 1 is a venting device *200*. Venting device *200*, installed on lid *120*, is provided for exhausting cooking fumes. Detailed discussion about venting device *200* shall be provided later on, when a forced venting system is disclosed.

[0057] A coupling device *1 34* is provided for coupling drive shaft *108* and a stirring blade *136* for transferring rotation power. The lower portion of coupling device *136* generally forms a cylindrical configuration or any other suitable configurations and is engaged with blade *1 36*. A coupling element *1 38* on coupling device *134* is provided for lockably receiving shaft *108*.

[0058] Blade *1 36*, rotatably and removably installed inside container *102* on the central bottom thereof, is provided for stirring foods. The design of blade *1 36* can be substantially different, as known to those skilled in the art. The front portion of blade *1 36* is close to the bottom of container *102* with a small-predetermined clearance for better scooping up food pieces, as shown in FIG.6, which illustrates a cross-sectional view of blade *136*. The rear portion of blade *136* extends gradually upward and serves for lifting up/turning over food pieces. The clearance between the front portion of blade *136* and the bottom of container *102* is minimized for ideal performance.

[0059] The speed, at which blade *136* sweeps across food pieces, is important. For too low speeds, blade *136* cannot scoop up food pieces and therefore food pieces cannot be agitated adequately to achieve the desired effect of homogeneous heating. Co-rotation of food pieces with blade *136*, as blade *136* rotates, is another important issue needs to be solved. Therefore, a higher speed is desirable for better performance of scooping up food pieces. However, for continuous operation of blade sweeping, when the speed is high, food pieces are agitated too much, for too long time, such that the texture of food pieces could be dam-

aged.

[0060] To solve this dilemma, an intermittent operation of blade sweeping is proposed in this invention disclosure. In this intermittent operation, blade *136* dwells for a predetermined interval of time after one or two rounds of sweeping, referred to as one stirring cycle, and then automatically begins another cycle of operation. This intermittent operation affords relief from constant stirring of food pieces at a higher speed, prolongs the utility life of blade *136* and a power-drive assembly *140*, and saves some energy required for driving blade *136*, as compared with a continuous operation. This intermittent operation also favors foods of great texture because during the predetermined dwell period, the food pieces have adequate time to be heated; which, in turns, favors foods of great looking. A computer control method and an electronic control circuit for achieving this intermittent operation shall be disclosed later on, when the control portion of apparatus *100* is discussed.

[0061] Power-drive assembly *1 40* includes drive shaft *1 08* and a drive motor *1 42*.

[0062] Motor *1 42* is installed on the outside bottom of outer container *104*. The motor shaft of motor *142* threads

through a central aperture on the bottom of container *104* and is coupled with drive shaft *108* through a proper coupling mechanism.

[0063] Drive shaft *1 08* is operationally coupled with motor *1 42*, directly for a low-speed motor or via some gears or belt-pulley devices for a high-speed motor. The upper portion of drive shaft *1 08* is engaged with coupling device*1 3 4* via coupling element *138*. Drive shaft *108* is installed on container *104* via a bearing element *14 5*, which is better illustrated in FIG. 7.

[0064] A seal device*144* is provided for sealing between shaft *108* and container *102*, as shown in FIG. 7, which illustrates a cross-sectional view of seal *144*. Seal *144* comprises a seal flange *146*, a gland nut *148*, and a compression packing *150*.

[0065] Flange *146* is co-axial to shaft *108*. The first end of flange *146* is sealingly installed on the inside surface of the central bottom of container *102*. The second end of flange *146* emanates upwards to a predetermined height above the bottom of container *102*. Gland nut *148* is engaged with the second end of flange *146* by means of screw. Packing *150* creates a seal by being squeezed between the throat of the stuffing box formed by flange *146* and gland nut

148. The squeeze force pushes the material of packing *150* against the throat of the box and rotating shaft *108*.

[0066] When leakage occurs, gland nut *148* is tightened further. This is a typical application of compression packings for low speed rotating shafts, such as shaft *108*.

[0067] Materials are extremely important when selecting the proper packing for an application. Metallic packings are used in high-temperature applications. Shafts for copper and aluminum packings must be hardened to 500 Brinell hardness number (Bhn). Copper and aluminum packings can handle 538°C (1000°F) application temperature.

[0068] Seal *144* can, alternatively, take many other forms, such as bushing and labyrinth seals, or combinations of multiple forms for ideal performance, as known to those skilled in the art and suggested by this invention disclosure.

[0069] There is an important advantage of installing seal *144* inside container *102*. For most applications, seal *144* is disposed higher than hot liquids, such that the sealing surface is not immersed in hot liquids. Therefore, the requirement on seal*144* is significantly reduced. In addition, shaft *108* is much better supported at a higher position. In operation, the lower portion of coupling device *134* is routed over seal *144*.

[0070] As shown in FIG. 1, venting device *200* includes a venting conduit *206* and a venting filter *208*. The first end of venting conduit *206* is mounted on lid *120*. There is an opening on lid*120*inline with venting conduit *206* for allowing cooking fumes to be forced out therethrough. Venting conduit *206* also serves as a bracket for holding venting filter *208*. Venting filter *208* is removably engaged with venting conduit *206*. Venting filter *208* further includes a disposable paper or fabric filter *208a* and/or a disposable activated charcoal filter *208b*, together, forming an integrated multi-stage filtering system.

[0071] Venting filter *208* is provided to trap the grease impurities in the grease-laden air forced out from inside apparatus *100*. Venting filter *208* is, preferably, made of one or multiple layers of metal meshes, such as aluminum ones. Metal meshes have different sizes of meshes and overlap each other. When cooking fumes pass therethrough, the oil particles will be trapped thereon. Filters *208a* and *208b* are provided to further remove the remaining oil vapor and chemical contents in cooking fumes and for the removal of cooking fume odors before the air is exhausted into the room.

[0072] FIGS. 3 and 4 illustrate a blowing device *202*. FIG. 3 illus-

trates a top view of apparatus *100*, indicating the layout of various parts/devices on lid *120*, and FIG. 4 illustrates a cross-sectional view of apparatus *100*, taken along line A-A of FIG. 3, indicating blowing device *202*.

[0073] A blowing motor *214* is provided for powering a fan *216*. Fan *216* is connected to motor *214* on the shaft and inserted inside an in-take conduit *210*. A conduit *212*, disposed on lid *120*, is in communication with conduit*210* and leads to a one-way valve *218*. A seal element *215* is provided to seal the connection interface around conduits *210* and *212*, when lid *120* is at a closing working position.

[0074] As shown in FIG. 8, which illustrates an exploded cross-sectional view of valve *218* of FIG. 4. Valve *218* includes a valve housing *220*, a valve body *222*, a covering piece *224*, and a biasing spring *226*. There are apertures on valve housing *220* for allowing air to pass therethrough. Valve body *222* is engaged with the open end of valve housing *220*. There are apertures on valve body *222* for allowing air to pass therethrough. Covering piece *224* covers on valve body *222* for closing and opening valve *218*. There is a central protrusion on covering piece *224*. The central protrusion is slidably inserted into a central aperture on valve body *222*, such that the protrusion can slide along the

central aperture for a predetermined distance. Spring *226* is attached between the protruding end of the protrusion and valve housing *220*, such that spring *226* is biased in slight tension, thereby pulling covering piece *224* toward/against valve body *222* for closing up valve *218*.

[0075] When blowing device *202* is in working condition, the air pressure generated by fan *216* forces covering piece *224* to slide away from valve body *222*, such that valve *218* is in opening state for allowing air to pass therethrough. Valve *218* is provided for preventing cooking fumes inside apparatus *100* from escaping through blowing device *202* while blowing device *202* is temporarily not in working condition.

[0076] Those skilled in the art will appreciate in view of this invention disclosure that many other suitable valve designs are readily applicable for this application of the present invention.

[0077] Venting device *200* and blowing device *202* can be alternatively installed on apparatus *100* at many other proper positions. For example, venting device *200* can be alternatively installed on an upper portion of container *102* and blowing device *202* can be alternatively mounted on lid*120*. These variations are, therefore, covered by this invention

disclosure.

[0078] Venting device *200* is provided for cooking fume treatment and blowing device *202* is provided for forcing moisture content out of apparatus *100*, such that apparatus *100* can fry foods of great taste, great texture, and great looking. However, there is some heating energy loss associated with using blowing device *202*. Therefore, the use of blowing device *202* should be in a controlled manner.

[0079] Stronger blowing favors better inside airflow for better facilitating moisture removal. However, Continuous strong blowing will cause excessive heating energy loss. To solve this dilemma, an intermittent venting operation is proposed in this invention disclosure. In this intermittent venting operation, fan *216* is de-energized for a predetermined interval of time near the end of a blowing cycle, e.g., of 10 seconds, and then automatically begins another cycle of operation. An electronic control circuit for achieving this intermittent operation shall be disclosed later on, when the control portion of apparatus *100* is discussed.

[0080] Immediately after a frying process is satisfactorily accomplished, the food is still hot and there is still residual cooking fume residing inside apparatus *100*. Blowing de-

vice *202* can be used to bring in fresh air to cool the food down fast to a predetermined temperature and, at the same time, to purge the residual cooking fumes out through venting device *200*. This process greatly favors safety of food handling, home environment protection, and foods of great texture and looking, especially for fried and roasted foods.

[0081] The above-discussed forced venting system is good for frying, roasting, baking, etc. For stir-frying, especially for frying vegetables, it favors foods of great looking. It is a well-known fact that when fried using a conventional frying pan with a lid covering on top thereof, green vegetables tend to become yellowish, soggy, and limp.

[0082] Reference is made to FIG. 2. An ingredient adding conduit *250*, installed on lid *120*, is provided for use to add ingredients, such as salt, pepper, soy sauce, etc., during a frying process. A cap *252* is provided for closing up conduit *250* when conduit *250* is not in use.

[0083] Reference is made to FIG. 5, which illustrates a cross-sectional view of apparatus *100*, taken along line B-B in FIG. 3. A safety switch *254* is provided on the upper edge of housing *106*. When lid *120* is lifted up, switch *254* shall shut down the power to motors *142* and *214* and heating

device *128* for safety considerations.

[0084] Reference is made to FIG. 1, again. A control housing *1 52* is provided for housing electrical control devices or elements and supporting a control panel *154*. Control housing *1 52* is installed on the sidewall of housing *106*. Control panel *1 54* is provided for supporting elements, like switches, indicators, adjusting knobs, beepers, LCD, and so on.

[0085] FIG. 9 illustrates a block construction diagram of a control circuit *1 6 2* for controlling various functions of apparatus *100*, such as temperature for frying foods, motor speeds for rotating blade *136*, and the speed at which blowing motor *214* is rotating. Circuit *1 6 2* comprises a microcomputer *1 6 4*, which controls various functions of apparatus *100*, a relay *1 6 5*, which activates heating device*12 8*,a relay *1 6 6*, which activates heating device*11 8*, a relay *1 6 8*, which activates motor *142*, and a relay *1 7 0*, which activates motor *214*.

[0086] Microcomputer *1 6 4* is provided with ROM and RAM for data memory, and further provided with I/O ports A/D converters as interfaces. The aforementioned ROM"s comprises a ROM *1 7 2* containing control programs related to the performance of frying processes and a ROM *1 7 4*,

which memorizes referenced data.

[0087] A temperature sensor *1 76*, disposed at a proper position, is provided for measuring the temperature inside container *102*, which is taken by microcomputer *1 6 4*, as an input variable to be controlled. When the temperature is above the user's desired one, the electrical power to heating devices*11 8*and *128*will be shut down by relays *1 6 5* and *1 6 6* to better meet the user's desired frying requirement and to save energy.

[0088] Computer *1 6 4* can be such programmed that relay *1 6 8* activates motor *1 42* intermittently with a bias toward a longer dwell after each stirring cycle of one or two rounds of rotation. In the same manner, an intermittent venting operation can be programmed with relay *1 7 0* activating motor *214* intermittently.

[0089] Reference is made to FIG. 10, which illustrates a schematic diagram of a control circuit *50* for providing the intermittent operation of blade sweeping for apparatus *100*.

[0090] As shown in FIG. 10, drive motor *1 42* is operationally coupled with blade *136* for providing rotation power. Motor *142* has a first terminal, which is connected to V-, the negative pole of a power source, and a second terminal, which is connected to the collector terminal of a PNP

bipolar transistor *51*. The emitter terminal of transistor *51* is connected to V+, the positive pole of a power source. Associated with motor *1 42* is a linkage mechanism *52*, which cooperates with a single pole, double throw switch *53*, such that the shaft angle of motor *1 42* controls the switching position. Switch *53* includes a single pole *54*, which is connected to the first end of a capacitor *55*. Pole *54* may be switched alternately between two throw positions as represented by RUN and REST. The reference RUN refers generally to the position of blade *136* when in sweeping. On the other hand, the reference REST refers generally to the position of blade *136* when in dwelling. The RUN position represents substantially a large portion of a whole round of rotation angle of the motor shaft, e.g., over 80%. The RUN position is associated with V- and the REST position is associated with V+.

[0091] A main switch *56* is provided for activating and deactivating the intermittent operation provided by circuit *50*. Switch *56* has a first terminal connected to V- and a second terminal connected to the first end of a variable resistor *58*.

[0092] The second end of capacitor *55* is connected to the second end of resistor *58*. Also connected to the second end of

capacitor *55* are the base of transistor *51* and the second end of a resistor *59*. The first end of resistor *59* is connected to the first terminal of a STIR switch *60*, which can activate a STIR feature, a manually activated continuous operation. The second terminal of switch *60* is associated with V-. The first end of resistor *59* is also connected to the second end of a capacitor *61*. The first end of capacitor *61* is connected to V-.

[0093] Switch *60* is a push button switch for activating the STIR feature. When switch *60* is pushed, the two terminals are connected, which causes the connection of the first end of resistor *59* to V- and, at the same time, causes capacitor *61* to be short-circuited.

[0094] With switch *56* in the activated position and switch *60* in the deactivated position, circuit *50* will operate blade *136* intermittently with a variable dwell period at the end of each sweeping cycle. This intermittent operation is achieved through the circuit of transistor *51*, switch *53*, capacitor *55*, and resistor *58*.

[0095] Now, to start with, suppose motor *1 42* has not been operating because switch *56* has been in the deactivated position. Also suppose switch *53* has been in the REST position, and thus capacitor *55* has been discharged.

[0096] When switch *56* is activated, the potential at the second end of resistor *58* will be lowered to cause transistor *51* to switch to conductive state, thereby energizing motor *1 42*. As soon as motor *1 42* begins to rotate, switch *53* will be thrown to the RUN position, which causes the first end of capacitor *55* to be connected to V-. Capacitor *55* will then begin to charge so as to make the second end of capacitor *55* positive with respect to the first end thereof. Sufficient base current will be provided through the base of transistor *51* to cause transistor *51* to remain conductive even after capacitor *55* becomes fully charged, thereby causing motor *1 42* to continue to rotate throughout a full rotation cycle until switch *53* is cycled back to the REST position. When switch *53* cycles back to the REST position, the first end of capacitor is then connected to V+ and capacitor *55* begins to discharge through resistor *58* until the potential at the second end of resistor *58* becomes sufficiently negative relative to V+. During this period of time, transistor *51* is switched to and remains in non-conductive state, thereby stopping motor *1 42* for a predetermined interval of time. And then, sufficient base current flow resumes, causing transistor *51* to become conductive again, and a new cycle starts.

[0097] The length of the dwell interval is determined by the time required for capacitor *55* to discharge. Proper selection of capacitor *55* and resistor *58* will provide desirable dwell intervals.

[0098] With resistor *59* and capacitor *61* in addition, a manually activated continuous blade-sweeping feature can be achieved in addition to and in combination with the controllable variable dwell feature. This performance feature is achieved regardless of whether switch *56* is in the activated position or not when switch *60* is pushed. Moreover, it will be seen if switch *56* is in the activated position when switch *60* is pressed, there will be an immediate override of the intermittent operation. The continuous operation will keep on going without any dwell for a predetermined number of cycles, for example, one or two, after switch *60* is released, before the intermittent operation is resumed. If switch *56* is in the deactivated position when switch *60* is pressed, motor *1 42* will immediately start to rotate. After switch *60* is released, motor *1 42* will continue for a predetermined number of continuous sweeping cycles and then stops.

[0099] When switch *60* is pressed, the first end of resistor *59* is connected to V-. This allows sufficient current to flow

through the base of transistor *51* to switch transistor *51* to conductive state, thereby causing motor *142* to start and operate. By proper selection of the value of resistor *59*, this mode of operation will occur regardless of the positions of switches *53* and *56*, so long as switch *60* is depressed.

[0100] At the same time, pressing switch *60* causes capacitor *61* to be short-circuited such that any charge stored therein is discharged through the short circuit to V-. When switch *60* is released, the current flowing out of the base of transistor *51* will continue through discharged capacitor *61* until capacitor *61* recharges. As a result, transistor *51* will continue in conductive state and motor *142* will continue to operate at the normal speed. Transistor *51* will continue in conductive state for a predetermined period of time based on the time constant provided by resistor *59* and capacitor *61*, which are preferably selected to provide one or two continuous sweeping cycles without any dwell after switch *60* is released.

[0101] One important point worth mentioning is that if power-drive assembly *1 4 0* has a rotation reduction mechanism, linkage *52* should be set between the output shaft of assembly *1 40* and switch *53*, instead of between motor *1 42*

and switch *53*.

[0102] If multiple rounds of sweeping are desired for a stirring cycle, before one dwell period, e.g., two rounds of sweeping before one dwell period, a pair of gears, or some other mechanisms, should be provided, with the smaller one installed on the output shaft and the larger one cooperating with switch *53*. The transfer-ratio should be 1:2.

[0103] The intermittent operation of blade sweeping can be alternatively achieved using a mechanically controlled timer, e.g., a spring-driven timer (not shown). Numerous discrete contact poles can be provided on a circular plate, such that when a needle is rotating around a central shaft, the needle engages with each contact pole in sequence. The angle range of each pole represents a stirring cycle. At the end of each stirring cycle, there is a predetermined dwell period, which is represented by the angle range in between two adjacent poles.

[0104] Reference is made to FIG. 11, which illustrates a schematic diagram of a control circuit *70* for providing the intermittent venting operation for apparatus *100*.

[0105] As shown in FIG. 11, blowing motor *214* is operationally coupled with fan *216* for forcing fresh air into apparatus *100*. Motor *214* has a first terminal, which is connected to

V-, and a second terminal, which is connected to the collector terminal of a PNP bipolar transistor *71*. The emitter terminal of transistor *71* is connected to V+. The base of transistor *71* is connected to the second end of a variable resistor *72*. The first end of resistor *72* is connected to the second end of a capacitor *73*. The first end of capacitor *73* is connected to V-.

[0106] Also connected to the first end of resistor *72* are the second terminal of a magnetically activated switch *74* and the first terminal of a VENT switch *75*. The first terminal of switch *74* and the second terminal of switch *75* are connected to V-.

[0107] Switch *74* is provided for activating and deactivating the intermittent venting operation provided by circuit *70*. Switch *74* communicates with motor *142*, such that when motor *1 42* is in working state, switch *74* is activated and remains in activated condition until motor *1 42* ceases to work. Switch *75* is a push button switch, which is provided for activating a manually activated continuous venting feature.

[0108] When either switch *74* or switch *75* is activated, the first end of resistor *72* is connected to V- and, at the same time, capacitor *73* is short circuited to V-.

[0109] With switch *74* in the activated position and switch *75* in the deactivated position, circuit *70* will operate fan *216* intermittently with a variable dwell period at the end of each venting cycle. This intermittent venting operation is achieved through the circuit of transistor *71*, resistor *72*, capacitor *73*, and switch *74*, which is conditioned by motor *1 42*.

[0110] When motor *1 42* is in working state, switch *74* is activated, such that the first end of resistor *72* is connected to V-, and capacitor *73* is short circuited to V-. The potential at the second end of resistor *72* is lowered to cause transistor *71* to switch to conductive state, thereby energizing motor *214*. As soon as motor *1 42* stops, switch *74* is deactivated. The current flow out of the base of transistor *71* will continue through discharged capacitor *73* until capacitor *73* recharges. As a result, transistor *71* will continue in conductive state and motor *214* continue to operate at the normal speed. Transistor *71* will continue in conductive state for a predetermined period of time based on the time constant provided by resistor *72* and capacitor *73*, which are preferably selected to provide a multiple of a sweeping cycle of blade *136*, e.g., five continuous blade sweeping cycles. Motor *214* then dwells for a predeter-

mined interval of time until the next cycle of the intermittent operation of blade *136* starts, when motor *1 42* activates switch *74*, again.

[0111] With switch *75* in addition, a manually activated continuous venting performance feature can be achieved in addition to and in combination with the controllable variable dwell feature. This performance feature is achieved regardless of whether switch *74* is in the activated position or not when switch *75* is pushed. Moreover, it will be seen if switch *74* is in the activated position when switch *75* is pressed, there will be an immediate override of the intermittent venting operation. The continuous operation will keep on going without any dwell for a predetermined interval of time after switch *75* is released, before the intermittent venting operation is resumed. If switch *74* is in the deactivated position when switch *75* is pressed, motor *214* will immediately start to rotate. After switch *75* is released, motor *214* will continue for a predetermined interval of time, and then stops.

[0112] FIG. 12 illustrates a perspective view of a perforated basket *1 8 8* for use with apparatus *100*. Basket *1 8 8*, provided primarily for deep-frying foods, is preferably cylindrical in configuration and has an upstanding inner cylindrical wall

1 8 8a defining a central aperture and a basket handle *1 8 8b* for handling basket *1 8 8*.

[0113] Wall *1 8 8a* is installed on the central bottom of basket *1 8 8*, so as to emanate up toward the upper portion thereof, and removably receives seal *144* therethrough. Handle *1 8 8b* is installed on the upper portion of basket *1 8 8*. Some small recessions, disposed on the upper edge of containers*102* and *104* and housing *106*, are provided to allow metal rods *188c*connecting the main body of handle *1 8 8 b* and the main body of basket *1 8 8* to extend from inside to outside of apparatus *100*.

[0114] When basket *188* is no longer desired, a suitable covering mechanism*190*, which includes a covering piece *192* and a guide *194*, as shown in FIGS. 13 and 14, is provided to close the recessions on the upper edge of container *102*. FIG. 13 illustrates a working state when basket *188* is in use for deep-frying foods and FIG. 14 illustrates a working state when basket *188* is no longer in use. Guide *194* is installed on an upper portion of container *102* and covering piece *192* can slide along guide *194*. There are recessions on the upper edge of covering piece *192*. At a position, as shown in FIG. 13, the recessions on covering piece *192* are inline with the recessions on the upper edge of

container *102*, such that basket *188* can be used. While at another position, as shown in FIG. 14, covering piece *192* close up the recessions on the upper edge of container *102*, when basket *188* is not in use, such that no cooking fumes pass therethrough.

[0115] In operation, a user: First, charges container *102* with some oil, and then preheats the oil to a predetermined temperature, preferably, halfway boiling. This step can be one step of a cooking program.

[0116] Second, charges container *102* with foods to be fried and some necessary ingredients.

[0117] Third, selects a temperature, a time duration, a stirring blade rotation speed, and a blowing motor speed, or a program for frying foods, and then pushes on a start button to activate a frying process.

[0118] The whole frying process is hand-free. The user does not have to be involved with the frying process until the frying is accomplished or the frying apparatus beeps to remind the user to add more ingredients.

[0119] For the embodiment discussed above, when the inner container is large, the stirring blade is consequently large, such that it may not be quite convenient to use or handle. In order to solve this problem, for a frying apparatus hav-

ing a large inner container, the lower portion of this inner container can be adapted to taper inward, such that the bottom of the container has a smaller diameter. Consequently, the stirring blade can be designed smaller.

[0120] Accordingly, readers will see that this stir-frying apparatus of the present invention can be used to prepare tasteful fried foods. There are a bottom heating device and an overhead heating device, together, forming a highly efficient heating system, such that foods are heated faster and more uniformly. Frying processes are executed in an automatic manner, thereby minimizing human involvement and chore in preparing foods. This frying apparatus is used with the lid fully covering on top of a container, thereby eliminating the possibility of grease splattering and the risk of oil burns to people. At the same time, the grease-laden air generated during frying processes is forced out through a venting device and filtered before being discharged into the room, thereby avoiding long-term hazards to the people and home environment.

[0121] The stirring blade sweeps across food pieces intermittently, such that the blade dwells for a predetermined dwell period starting near the end of each stirring cycle. This intermittent operation favors better agitation of food

pieces and affords relief from constant stirring of foods at a higher speed.

[0122] The present invention has been described in an illustrative manner. It is to be understood that the terminology, which has been used, is intended to be in the nature of words of description rather than of limitation.

[0123] Although this invention has been described in its preferred forms and structures with a certain degree of particularity, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention.

[0124] For examples, although this invention has been described in a form of home frying apparatuses, it can have potential business use, such as use in restaurants. Therefore, this invention can alternatively be described as food processing equipment. Although the forced venting system of this invention has been described in a form of blowing fresh air into the frying apparatus, it is understood that rearrangement of the motor, fan, and filters, such that, instead of blowing fresh air into the frying apparatus, the fan actually draws the moisture-laden and grease-laden air out of the frying apparatus, is perfectly inline with the

spirit of the forced venting concept of this invention. Such rearrangement is, therefore, covered by the present invention.

[0125] Thus it is understood that the present disclosure of the preferred forms can be changed in the details of construction and in the combination and arrangement of parts without departing from the spirit and the scope of the invention as hereinafter claimed.